

## **Ecosystem Restoration**

**Jerry L. Rasmussen  
U.S. Fish & Wildlife Service  
P.O. Box 774  
Bettendorf, IA 52722-0774**

River ecosystems are faced with monumental impacts and problems as a result of man's actions to alter his environment. State and Federal biologists have been working on mitigation efforts since the 1940's, but these have largely been piecemeal, showing only marginal success; and most successes have been off-channel in off-site trade-offs providing little or no benefit to riverine fisheries.

In response to this problem, a team of international scientists gathered in La Crosse, Wisconsin in 1994 to discuss restoration of the ecological integrity of floodplain rivers (Delaney 1995). Their meeting reached several important conclusions which management biologists can and are using to supply their arsenal of scientifically supported information and guidelines. They include the following:

- River form is a function of the totality of land use patterns in the basin.
- There is an integral relationship between a river's main channel and its floodplain.
- The flood pulse and morphological diversity arising from it are the major driving factors in floodplain river ecosystems.
- A primary attribute of river integrity is the connectivity of floodplain habitats with the main channel.
- The biggest stresses on large rivers are produced by high dams, reservoirs, and floodplain levees.
- Restoring integrity involves freeing the river to some extent to maintain, rebuild and rejuvenate itself by the natural processes of scouring and deposition.
- General guidelines that can now be advocated by scientists include (1) the removal or setting back of levees to allow the river to adjust locally; (2) local floodplain restoration; and (3) removal of lock and dam systems or lateral levees that are no longer socially or economically justified.
- Alternatively, water regulation procedures at navigation locks and dams could be modified to increase floodplain connectivity during appropriate seasons.
- The area needed for an improvement to the biota is probably relatively small, and may take the form of a series of floodplain patches connected by more restricted river corridors.
- Ultimately, integrated management should be extended into the river catchments to reduce inputs of sediment, nutrients and chemicals.

In essence, what these scientists have said is that in order to restore a river's ecological integrity, one thing that must be done is to reconnect it to some portion of its floodplain — this means that biologists must work closely with engineers in the design of future flood control measures.

Also in 1994, as part of the White House response to the 1993 Midwest flooding, USGS scientists said that on channelized alluvial rivers like the Missouri, the best way to provide for flood control is to enclose the river's entire meander belt within a system of setback levees. The meander belt is the zone immediately adjacent to the river. It is the area most susceptible to flooding, the area where old active river channels occur, and where most of the major levee breaks occurred during the 1993

flood. The meander belt is thus that portion of the floodplain least desirable for farming or other developmental uses. So there is a situation here where both biological and physical scientists agree that we must loosen the stranglehold we have had on our rivers and their floodplains, and a win-win situation may exist, where we can address both economic and environmental objectives at the same time.

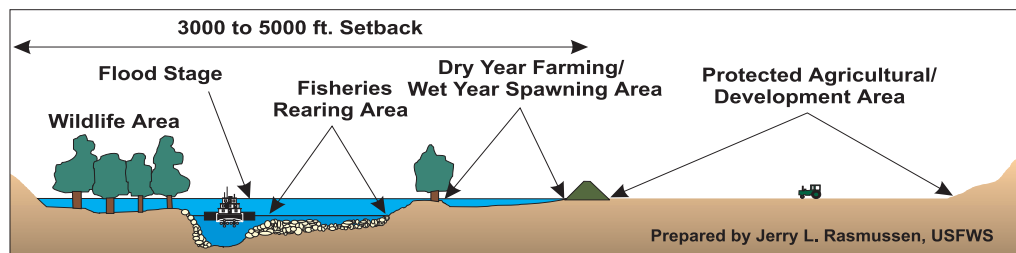
The proposed system of setback levees would look something like the diagram shown in Figure 1. Permanent farmland would be well protected behind the setback levees. Compatible land uses could occur between the

levees. The higher ground, riverward of the levees, would serve nicely as dry year farm-land, and as fish spawning areas during wet years.

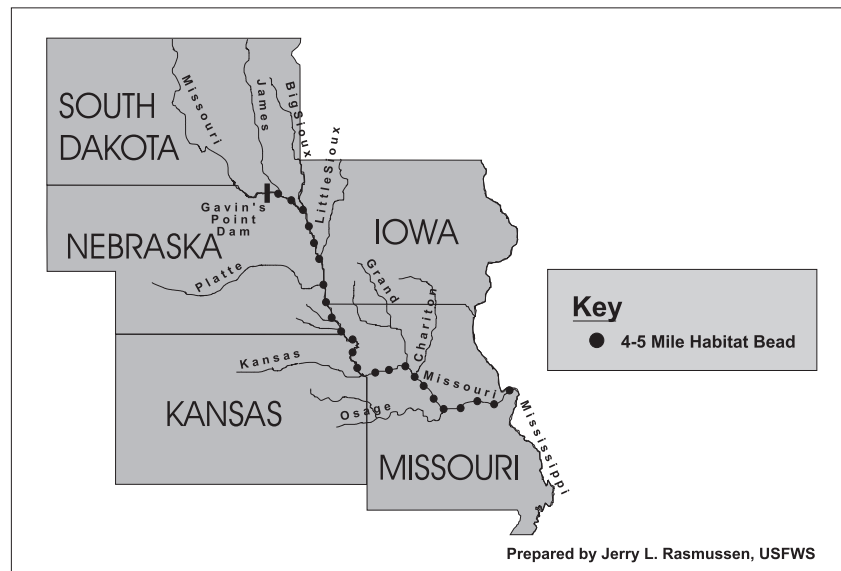
Farming of such lands, however, should be completed at the sole risk of the farmer. Those areas that were abandoned for farming and became wooded, would likely become permanent wildlife habitats or open pastures. Channel margin areas would provide permanent fish rearing areas. So its easy to see how such a systemwide approach or vision for flood control, coupled with seasonal inundations, could also achieve acceptable levels of ecosystem restoration and meet the needs of many of our threatened species.

But while a system of setback levees may be needed to address flood control; purely from an ecological perspective, we feel that far less land and habitat restoration is needed to restore a river's ecological integrity. Based on the scientific literature and the consensus reached at the international meeting in La Crosse, WI (Delaney 1995), restoration of a river's ecological integrity could be achieved by simply restoring a series of key habitats, stretched over its length, like a string of habitat beads or pearls (Figure 2). These habitat beads would be managed in an attempt to restore some semblance of the river's natural features, or "Dynamic Equilibrium" in localized areas.

Such a habitat bead might appear as in Figure 3. It would incorporate the use of setback levees and



*Figure 1. Setback levees provide for ecosystem management, balancing developmental and environmental needs, while preserving river floodplain integrity.*

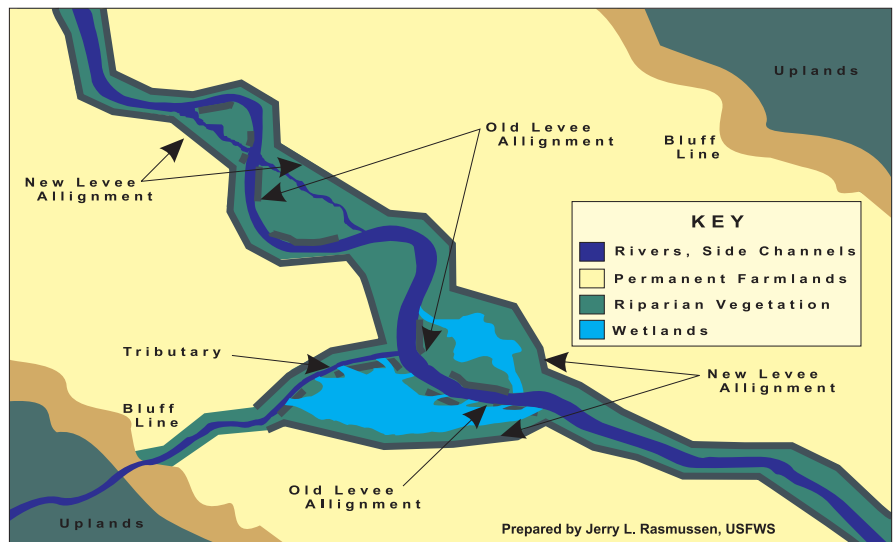


*Figure 2. Map showing a hypothetical proposed habitat restoration program along the lower Missouri River using the 4-5 mile habitat bead concept.*

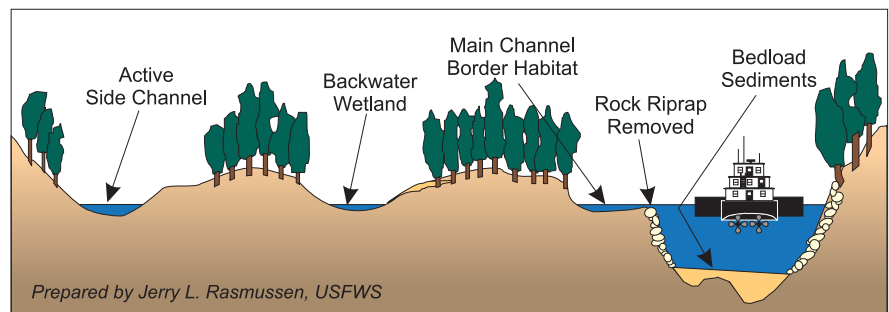
include several habitat features (e.g. side channels, wetlands, wet meadows, bottomland hardwoods, etc.) and attempt to incorporate tributary mouths and low lying areas. These areas are the most vulnerable to flooding, and would be easy to periodically inundate with small seasonal rises in water elevation. Such water level rises could be accommodated by controlled water releases from upstream flood control and hydropower dams. Operation and maintenance costs would thus be low, and because these areas lie on the lowest floodplain elevations, flooding impacts on nearby land-owners would be minimized.

When a navigation or bank stabilization project is present, the ability to inundate adjacent lands with lower elevation flood pulses could be enhanced by removing some of the existing bank stabilization features along shorelines adjacent to target habitats. This would allow lower elevation flows to reach floodplain habitats within the habitat bead (Figure 4).

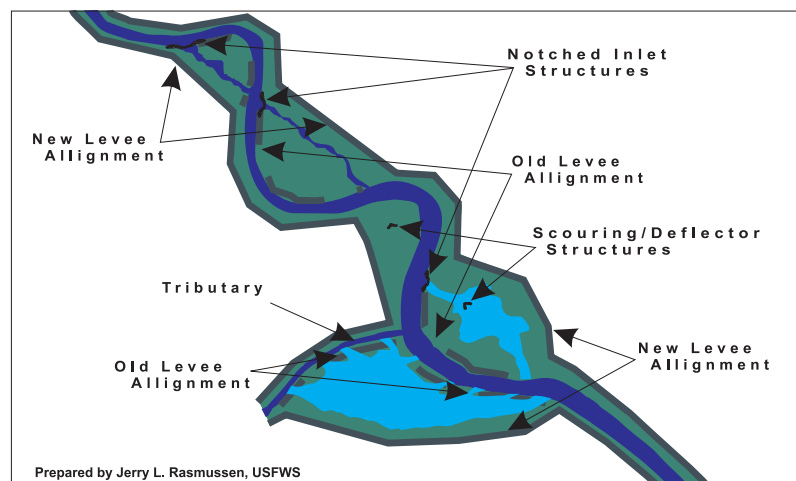
Looking closer at such a habitat bead from above (Figure 5), notched inlet structures could be placed at the upstream ends of any new channels. This would serve a dual purpose, preventing river bedload sediments from entering and filling



**Figure 3.** A hypothetical river reach showing a series of habitats functioning as an ecological “bead” or “patch” of habitat necessary to restore or maintain ecological integrity.



**Figure 4.** Removing some rock riprap widens river top width, recovers some bedload sediments, and allows excess channel water to “spill” onto the floodplain, rewatering habitats.

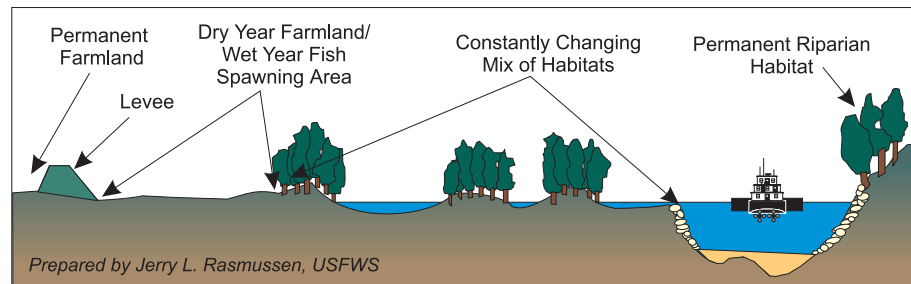


**Figure 5.** Notched inlet structures and deflecting/scouring devices would protect main channel integrity and promote floodplain scour in desired areas.

the new channels and wetlands, and also preventing the new channels from capturing too much of the main channel flow, avoiding disruption to any navigation or water supply needs.

Even within many habitat beads, dry year farming would be desirable (Figure 6). As with refuges on other rivers, farmer cooperators could operate on a crop share basis, sharing the risk of gain or loss with the public or non-public owners. These habitats could thus be owned by any combination of federal,

state, local, or private entities, but to properly address ecosystem needs they should be linked together through some form of intergroup, cooperative management agreement or plan.



**Figure 6.** Dry year “cooperative farming” could be used to enhance wildlife habitat in many managed habitat beads.

Eventually in this vision, we could have restored floodplain habitats strategically placed along many of our Nation’s rivers (Figures 7 and 8). These habitats would not only address ecosystem needs, but would also provide significant beauty as well as space for flood water storage and conveyance,



**Figure 7.** View of the Minnesota Valley National Wildlife Refuge, a restored Minnesota River floodplain ecosystem near the Twin Cities, MN.



**Figure 8.** View of Hamburg Bend, a restored Missouri River floodplain ecosystem near Nebraska City, NE.

thus providing a significant margin of flood protection for nearby lands. It is likely, that once the word got out of these benefits, every city and town along our rivers would want one or more of these restored reaches nearby, not only to provide a margin of flood protection, but also as sources of revenue, beauty and recreation.

The goal of large river fisheries managers is thus to restore some semblance of “dynamic equilibrium”, at least to portions of our great rivers, moving away from the more sterile channelized paradigm of the past as shown on the right in Figure 9. Through proper management, we can maintain both quality economic and ecological systems, but to accomplish such a goal, every stakeholder must be willing to share these great resources. We must move beyond the age of domination by

single purpose uses such as commercial navigation, flood control, or hydropower.

### **References**

Delaney, R. L. 1995. Sustaining the Ecological Integrity of Large Floodplain Rivers; Synthesis of International Conference, July 12-15, 1994. La Crosse, Wisconsin. In: *The Upper Mississippi River: Sustainable Redevelopment Alternatives*. Northeast-Midwest Institute. 218 D. Street S.E., Washington, D.C. pp. 41-43.



*Figure 9. A comparison between a channelized river (right) and a natural river (left).*

Jerry L. Rasmussen, March 9, 1999